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To cite this article: Colin Greaves, Leon Poltawski, Ruth Garside & Simon Briscoe (2017): Understanding the challenge of weight loss maintenance: A systematic review and synthesis of qualitative research on weight loss maintenance, Health Psychology Review, DOI: [10.1080/17437199.2017.1299583](https://doi.org/10.1080/17437199.2017.1299583)

To link to this article: <http://dx.doi.org/10.1080/17437199.2017.1299583>



Accepted author version posted online: 10 Mar 2017.



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Publisher: Taylor & Francis & Informa UK Limited, trading as Taylor & Francis Group

Journal: *Health Psychology Review*

DOI: 10.1080/17437199.2017.1299583

Understanding the challenge of weight loss maintenance: A systematic review and synthesis of
qualitative research on weight loss maintenance

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Key words: Weight loss maintenance; Behaviour change; Qualitative; Evidence Synthesis

Funding

This report is independent research supported by the UK's National Institute for Health

Research (Career Development Fellowship CDF-2012-05-259) and the National Institute for

Health Research (NIHR) Collaboration for Leadership in Applied Health Research and Care of the South West Peninsula (PenCLAHRC). Dr R Garside's time is partly financed by the European Regional Development Fund Programme and European Social Fund Convergence Programme for Cornwall and the Isles of Scilly. The views expressed are those of the authors and not necessarily those of EU, NIHR or the UK Department of Health.

Abstract

Behaviour change interventions can be effective in helping people to lose weight, but weight is often regained. Effective interventions are required to prevent this. We conducted a systematic review and synthesis of qualitative research on people's experiences of weight loss maintenance. We searched bibliographic databases for qualitative studies about the experience of currently or previously overweight adults trying to maintain weight loss. We thematically synthesised study findings to develop a model of weight loss maintenance. Twenty six studies from five countries with 710 participants were included. The model developed through our synthesis proposes that making the behaviour changes required for weight loss maintenance generates psychological "tension" due to the need to override existing habits, and incompatibility of the new behaviours with the fulfilment of psychological needs. Successful maintenance involves management or resolution of this tension. Management of tension can be achieved through self-regulation, renewing of motivation and managing external influences, although this can require constant effort. Resolution may be achieved through changing habits, finding non obesogenic methods for addressing needs, and potentially through change in self-concept. Implications for the development of weight loss maintenance interventions are explored.

Key words: Weight loss maintenance; Behaviour change; Qualitative; Evidence Synthesis

Managing obesity to prevent type 2 diabetes, cardiovascular disease and other health conditions is a major global priority (National Institute for Health and Clinical Excellence [NICE], 2014; World Health Organisation [WHO], 2014). However, although a number of effective interventions and key intervention components for weight loss have been identified (Adams et al., 2012; Greaves et al., 2011; Padwal & Majumdar, 2007), weight regain is common (Dansinger, Tatsioni, Wong, Chung, & Balk, 2007; Dombrowski, Knittle, Avenell, Araujo-Soares, & Sniehotta, 2014). Following non-surgical interventions, people regain, on average, a third of the weight lost within a year and the rest in 3-5 years (Avenell et al., 2004; Dansinger et al., 2007). Even following bariatric surgery, around a quarter of the initial weight loss is regained over 6-10 years (Adams et al., 2012; Sjostrom, 2013). In order to address this, it is important to understand more about the phenomenon of weight regain.

A recent review of individual interventions to support weight loss maintenance found that the rate of weight regain can be reduced by a mean 1.6Kg per year (Dombrowski et al., 2014) and several specific intervention techniques, such as self-regulation (goal setting, self-monitoring, feedback) and problem solving, as well as increased physical activity, are associated with increased success (Madigan et al., 2014; Simpson, Shaw, & McNamara, 2011). However, even though some individuals are able to maintain weight loss with such interventions, on average weight is still regained. These reviews also show that the intervention methods used to support maintenance largely replicate or extend the same methods used for initial weight loss.

Further insights into the phenomenon of weight regain may be obtained through qualitative research methods. Qualitative research can focus on the perspectives and experiences of the person trying to maintain weight loss and provides an opportunity for theory building. Understanding the complex social, contextual, cognitive and emotional influences on weight loss maintenance might also help to identify new, innovative intervention strategies. A common criticism of qualitative studies is that their transferability may be limited to some

extent by their sample size and the specific setting or population studied. However, it is possible to combine the findings of such studies using meta-synthesis (Barnett-Page & Thomas, 2009; Britten et al., 2002). This can generate a more in depth understanding of the problem and may help to formulate models and theories that are applicable to a broader range of contexts (Barnett-Page & Thomas, 2009). Meta-synthesis of qualitative data has been used to help build understanding of a range of health conditions and develop interventions to address them (Britten et al., 2002; Carroll, Booth, & Cooper, 2011; Wingham, Harding, Britten, & Dalal, 2014). In this study we systematically reviewed qualitative studies of weight loss maintenance or weight regain in adults, and synthesised their findings. The aims of the synthesis were to (a) identify the range of factors and strategies that influence weight loss maintenance, and (b) generate a conceptual model that might inform future interventions.

Methods

We conducted a systematic review and thematic synthesis (Thomas & Harden, 2008) of qualitative studies of weight loss maintenance. The study protocol is available on the PROSPERO register (CRD42014008666), and this report follows ENTREQ guidance for reporting qualitative syntheses (Tong, Flemming, McInnes, Oliver, & Craig, 2012).

Eligibility criteria

We included peer reviewed papers published since 1990 in English which qualitatively assessed the views of currently or previously overweight adults about the maintenance of intentional weight loss. Studies that addressed maintenance within a broader investigation of weight management (e.g., mixed methods studies) were included if they contained substantial material relating specifically to maintenance. Based on assessment by two independent reviewers and negotiation around any disagreements, we classified articles as having “substantial material” if weight loss maintenance was a major focus of the study, or if at least several paragraphs of data or interpretation were concerned with weight loss maintenance.

Papers were excluded if the study population changed weight due to pregnancy, or as a side effect of medication, an eating disorder or other medical condition.

Literature Search

We searched Medline, EMBASE, CINAHL, PsycINFO, ASSIA, International Bibliography of the Social Sciences (IBSS) and Social Sciences Citation Index, using controlled vocabulary and free text search terms relating to overweight, weight management and weight loss maintenance. We adapted an existing evidence based search filter to identify qualitative studies (Wong, Wilczynski, & Haynes, 2004). Supplementary File 1 provides details of the search strategy. We conducted a “berry picking” search, whereby we entered the titles of our included papers into Google Scholar and used the “related articles” feature to identify potential additional articles. We also tracked citations from the reference lists of included publications using Web of Science, and consulted the authors of included studies where possible, in July 2014, along with 15 other experts in the field who were known to the authors, to identify relevant papers. The search was first conducted in February 2014 and updated in October 2015.

Screening and data extraction

Titles and abstracts were screened, and full texts obtained for any potentially eligible papers. These were read in full to establish eligibility and categorised according to the attention they gave to weight loss maintenance (coded as substantial, partial and minor or unclear). Only those in the “substantial” category were included in the synthesis. Study and participant characteristics were extracted, along with descriptions of features relevant to quality appraisal. The text of included studies was coded and organised using NVivo 10. Screening and data extraction was conducted by one researcher, and another independently screened 25% of papers both at this stage and during full text screening. Any disagreements were resolved by discussion but agreement levels were above 95% in each case.

Study appraisal

There is no clear consensus on methods for the appraisal of methodological quality in qualitative syntheses (Hannes & Macaitis, 2012). We appraised the studies on the basis of their trustworthiness, transferability and usefulness to our study, including assessment of methods of data collection and analysis, sample characteristics and study context (Wallace et al., 2006; Walsh & Downe, 2006). We assigned a rating of low, moderate or substantial for methodological quality and (separately) for value to our synthesis, based on the quality assessment criteria provided in Supplementary File 2. One researcher (Author2) appraised all the included studies and another (Author1) checked these ratings. All disagreements on study quality and usefulness were discussed and resolved between these two researchers. The appraisal process was not used to determine eligibility for inclusion in the synthesis, but to inform judgements about the strength of evidence for different elements of the synthesis, and as a source of information to help account for any discrepancies between study findings.

Analysis and synthesis

We adapted thematic synthesis methods described by Thomas and Harden (2008). Text and tables from the abstracts, results and discussion sections of papers were coded line by line to identify themes relating to weight loss maintenance. Coded data were additionally categorised as either verbatim quotes from study participants or interpretations by study authors. This process was initially conducted with eight papers, selected to represent a range of study populations and methods. Analysis was conducted independently by two researchers (Author 1, Author2), both of whom had training and experience in qualitative research methods and evidence synthesis. The resulting coding and descriptive themes were compared, discussed and agreed at several meetings. The remaining papers were then coded line by line by one researcher, and read by both researchers to identify any new themes or data suggesting variance or dissonance within or between studies. Summaries of the main findings and any models proposed in each study were also agreed. The reviewers met several times during the analysis process to generate a synthesis comprising higher level interpretive concepts and an explanatory

model linking them. Themes and concepts were iteratively developed by repeated comparison with extracted material from the individual studies, giving particular attention to identifying and seeking explanations for any deviant cases or dissonant themes. The summaries we created of the main findings of each study were also consulted, to ensure that the integrity of these findings was preserved in the synthesis.

We conducted a sensitivity analysis (Carroll, Booth, & Lloyd-Jones, 2012) to investigate whether any elements of the synthesis depended on the inclusion of lower quality studies. This involved removing the data from lower quality studies and checking the remaining level of support for the themes and concepts we had generated. Using a similar method, we also considered whether our findings were influenced by the inclusion of studies where bariatric surgery was used for initial weight loss.

Results

Search results and study selection

A PRISMA diagram of the search process is provided in Figure 1. The search yielded 2491 references, 26 of which were included in the review. Seventy studies in which weight loss maintenance was mentioned but not given substantial coverage, or was not distinguished from weight loss, were excluded from the synthesis (see Supplementary File 3).

Study characteristics and appraisal

Supplementary file 4 shows the characteristics of the included studies, which were conducted in Australia (2), Finland (3), Greece (1), Ireland (1), Sweden (2), the US (10) and the UK (7). They involved a total of 710 participants, 552 of whom (78%) were women. Ethnicity was not always reported but studies included African American, Caucasian and multi ethnic samples. Of the total sample, 296 participants (40%) were classed as successful weight loss maintainers. Definitions of successful weight loss maintenance varied, but the most common required maintenance of at least 10% bodyweight loss for at least one year. In many cases the weight loss was greater and the maintenance periods were considerably longer. Seventeen

studies specified that participants had initially lost weight by behaviour change alone; participants in five studies had had bariatric surgery; and five studies did not specify the methods of initial weight loss. Eleven studies made explicit comparisons between successful and unsuccessful weight loss maintainers. One study included interviews with 10 people who had stopped smoking (and were not trying to manage their weight), and three studies included 33 lifetime healthy weight maintainers. However, it was possible to identify the views of people who had experience of trying to maintain weight loss in these studies, so they were retained.

Our appraisal of the methodological qualities of the included studies and their value to our synthesis is summarised in Supplementary File 5. Only one study (Engstrom & Forsberg, 2011) was longitudinal, tracing changes in people's perceptions over time; the remainder were cross-sectional. Data collection was through focus groups (six studies), or individual interviews which were either face to face (15 studies), by telephone (two studies) or email exchange (one study), or using a combination of focus groups and face-to-face individual interviews (two studies). Evidence of trustworthiness was substantial in four studies, moderate in thirteen and limited in nine (see Supplementary File 5 for details). The main areas where trustworthiness was potentially threatened were lack of supporting quotes for interpretations, poor descriptions of recruitment and sampling, and poor evidence of researcher reflexivity. All but one paper were considered to be of moderate or high value to the synthesis.

Synthesis

Based on our analysis and interpretation of the data, we developed a set of common descriptive themes and sub-themes representing the data from the included studies. In doing this, we identified a number of factors (physiological, social, environmental or psychological influences on weight loss maintenance) and strategies (cognitive or behavioural approaches adopted by the individual to assist their weight loss maintenance). In keeping with the principles of thematic synthesis, we also developed "third order interpretations" (reviewer-generated concepts) that go beyond the content of original studies (Thomas & Harden, 2008).

This included a conceptual model of weight loss maintenance. In the following account, the themes (in italics) are organised within the conceptual framework that we developed. Table 1 indicates which studies supported each theme, either through participant quotes or interpretations made by their authors. Illustrative quotes are from the authors of papers unless specified as from a study participant, and participant descriptors are given where available. A more detailed table of quotes is in Supplementary File 6. The account is followed by a description and illustration (Figure 2) of the conceptual model that we developed to organise and relate the themes and concepts to each other.

The tension of maintenance.

Maintaining the changes is a struggle. Both weight regainers and maintainers depicted weight management as a constant battle, requiring significant and ongoing mental effort and resources and leading to cognitive fatigue. This was experienced both when trying to eat more healthily and when trying to increase physical activity. “Look, the maintenance phase is always the hardest for me. For I have to eat as much as when dieting, without losing weight” (Maintainer) (Karfopoulou, Mouliou, Koutras, & Yannakoulia, 2013). For many, it exacted an increasing toll, leading to instability in weight management behaviours, and a downward spiral in which negative thought patterns, maladaptive learning and poor coping strategies reinforced one another, eventually resulting in relapse and a return to the previous obesogenic lifestyle.

Sources of tension.

Old habits and impulses. Several sources of the above-mentioned tension were identified. Firstly, changing obesogenic behaviours involves breaking old, often long-ingrained habits and making new ones. Study authors noted the ever present potential to return to former eating or sedentary habits and a sense of being “somehow stuck with or habituated in a certain kind of lifestyle” (Jallinoja, Pajari, & Absetz, 2008) or being constantly “on guard” against their return (Lynch & Bisogni, 2014). One participant (regainer) reported that “It was very gradual. I didn’t really notice it. Kind of slipped back into old habits and it sort of crept on over a few

years and then sort of escalated” (Reilly et al., 2015). Related to this is the acknowledgement of impulsive responses to the presence of tempting foods in the environment as a particular problem. When tasty (and unhealthy) foods were present or offered, some individuals experienced transitory but strong impulses to overeat or “food cravings”, which could precipitate lapses (Green, Larkin, & Sullivan, 2009; Lynch & Bisogni, 2014).

Unmet needs. A second source of tension was the failure of new behaviour patterns to meet personal needs previously served by obesogenic behaviours. Unhealthy eating was widely cited as a strategy to help regulate emotion or stress, for the relief of boredom, and for delivery of simple pleasure. Following weight loss through bariatric surgery, one participant said “I eat when I’m sad, when I need comfort, when I celebrate or when I’m happy or hungry.” (Engstrom & Forsberg, 2011). In some cases, the need to overeat was characterised by respondents as a personal addiction. It was also seen as a necessary part of social or cultural engagement (e.g., eating for celebration or to fit in with a particular social group). “I found the only way around going out with friends was to sit at the table and not eat. That’s very hard” (Regainer) (Janse Van Vuuren, Strodl, White, & Lockie, 2015). Similarly, changes in physical activity could conflict with other priorities in life (often expressed as time pressure), or the need for social inclusion (e.g., through embarrassment around exercising in public). If behaviour changes for weight management disrupted the fulfilment of such needs, they could generate a sense of inner conflict. This was particularly evident among those who had undergone bariatric surgery, for whom the sudden incapacity to consume food for emotional regulation (and the effects on social eating) could be intensely distressing (Janse Van Vuuren et al., 2015).

Thoughts and beliefs about identity or self-concept. Tension could also be generated when new behaviours, or weight loss itself, appeared to cause conflicts with self-concept or identity. As one participant put it, “It’s a regime isn’t it, and I probably rebel from that a bit...so I, for me, I need to tame my—not my spirit, but personality I suppose” (Green et al., 2009). The conflict was expressed as a struggle between the individual’s “good” and “bad” selves in

everyday life (Green et al., 2009), and as of “a tension between the [individual’s] obese past and the present day” (Sarlio-Lähteenkorva, 2000). For some, weight loss was associated with a loss of physical power or sexual attractiveness (Sarlio-Lahteenkorva, 1998; Sarlio-Lähteenkorva, 2000). There was also discomfort at the perceived requirement to stigmatise the previous “overweight me”, and a sense of loss of a previous carefree self, unconstrained by a societal obsession with thin and perfect bodies. Weight management could also be seen as threatening social identity, for instance as a fun-loving, hedonistic member of a social group, or as a caring parent and spouse, who shows their love through providing (unhealthy) food to the family.

Thoughts and beliefs about weight management. These also fuelled inner conflict. Weight regainers often viewed weight management as a rigid, rule bound, all-or-nothing affair, to be endured temporarily until they lost weight. This often evoked a sense of deprivation and negativity or resentment, so that even positive outcomes could be judged as unsatisfactory. One regainer stated “I have very strict ideas about what failure and success are made of. In my head, I always think I’d like to be 8 stone. Obviously if you don’t get to 8 stone you’re still fat” (Byrne et al., 2003). Catastrophic thinking (i.e., thoughts of failure and hopelessness) in response to lapses was reported as a particularly negative pattern of thought that could lead to abandonment of weight management efforts. “It’s an obvious self-defeating concept that just because you have eaten one bad thing you should then eat lots of it. It’s some sort of weird psychological thing to think it’s all or nothing; if you can’t do it perfectly you might as well not do it at all.” (Maintainer) (McKee, Ntoumanis, & Smith, 2013). These negative scripts could become self-fulfilling as they undermined self-efficacy and belief in the possibility of positive outcomes (McKee et al., 2013).

Tension also appeared to be generated by conflict between lifestyle change and other priorities in life. This is captured in the model by the need for social inclusion (e.g., to prioritise the needs of other people). It also applies to some modifiers of tension (e.g., time pressures) and

to some identity-related beliefs (e.g., being competent at one's job). "I'm everywhere. I'm working and I'm doing their homework and it's all that tumbling down on top of you and you see you just grab whatever" (Participant) (Reilly et al., 2015).

Modifiers of the tension.

Factors influencing the challenge of maintenance. The tension of maintenance was experienced as a dynamic phenomenon, modified by personal, social and environmental factors that could change over time and in intensity (represented as the outer ring in Figure 2). Personal factors include illness and mood, which may cause sudden spikes in the tension of maintenance. The attitudes and behaviours of family and friends were thought to be particularly important external factors, influencing personal attitudes, motivation and maintenance behaviours. For example, one post-bariatric surgery female participant reported that "My mom is self-destructive and disapproving. She's a saboteur. She says that she wants to help me, but then she makes me brownies. It's frustrating" (Benson-Davies, Davies, & Kattelman, 2013). Karfopoulou et al. (2013) reported that "external factors leading to changes in everyday routines were frequently mentioned as causal, such as changes in marital status, changes at work, moving house or financial issues".

The challenge of weight loss maintenance is therefore to deal with the tension generated by changing habits, disrupting personal needs fulfilment and conflict with beliefs, and to manage the many contextual factors that influence the tension. Our analysis suggested two main ways of dealing with the tension of weight loss maintenance: managing it and resolving it.

Managing the tension.

Learning and insight. Several studies depicted a weight management journey in which the process of individual change is driven by learning through repeated experiences of dealing with the tensions of maintenance. The learning can be maladaptive, so that weight management becomes increasingly difficult. For example, some studies suggested regainers could become trapped in a negative emotional-cognitive-behavioural cycle in which eating provided

temporary relief for negative feelings about body image, but the resulting weight gain provoked further negative feelings and guilt, as well as a more generalised lowering of self-esteem and self-confidence. The “lessons” learned from experience in this scenario were counterproductive, increasing the chances of failure. In contrast, successful maintainers reported adaptive learning from their experiences of both success and failure in weight management. They “learned from past mistakes, made adjustments, and moved on” (Berry, 2004). More broadly, maintainers learned “what works for me” and found lifestyle behaviours that would be sustainable for them in the long term.

Over time, some individuals reported an increased awareness of how their weight related behaviours were influenced by personal attitudes, emotions, personal needs, other people and external circumstances. Study participants referred to specific insights that led to a breakthrough in either their attitudes or approach to weight management. For example, a realisation that food was being used to manage stress or boredom stimulated some participants to find alternative ways to manage these feelings (Benson-Davies et al., 2013; Haeffele, Trunnell, & Kinney, 2011).

This type of learning creates a dynamic that supports long term weight loss maintenance: Bertz et al. (2015) propose that the experience of a successful outcome following behavioural changes may increase motivation, improve self-image, and through repetition of this virtuous cycle lead to the eventual alignment of previously conflicting, cognitive and emotional drivers (Bertz et al., 2015). This positive feedback can then support further change and persistence with weight loss efforts. Furthermore, as people become increasingly skilful in managing the tension of maintenance, some reported that the effort required decreased over time (Haeffele et al., 2011; Jallinoja et al., 2008).

Self-regulation. Many of the strategies reported by successful maintainers are examples of self-regulation. These include setting targets and goals, regular self-monitoring of behaviour and outcomes, making plans to deal with “high risk situations”, and responding quickly to

lapses. So, for example, maintainers regularly checked their weight (by direct measurement, monitoring body shape, clothing fit or a more general sense of fitness and wellbeing). They also set boundaries for what constituted acceptable weight variation and used these as triggers for compensatory action when a lapse occurred. One maintainer stated “I give myself 10 pounds, but once you get to 10 pounds, turning that ship around is hard. So maybe I’ll adjust it to five pounds to be my alarm weight” (Reyes et al., 2012). Maintainers also reported using a stepwise approach to lapse management, in which eating and physical activity plans were normally flexible, but became more rigid (and more intensively managed) when warning signs were observed. Flexible restraint was a key principle for many maintainers, and rigidity was regarded as counterproductive, since it could increase the tension of weight management and so made sudden relapse more likely. These approaches contrasted with those of weight regainers, who appeared to use self-regulatory practices inconsistently or not at all. Self-weighing was unpopular because it might generate unwelcome news, and although in some cases weight gain boundaries were set, they were often ignored or reset when crossed, to avoid the perception of failure or the need to take remedial action (Chambers & Swanson, 2012).

Managing internal and external influences. Maintainers reported that they actively identified and found ways of addressing the personal and contextual factors that modified the tension of maintenance. They established explicit strategies to identify and deal with high risk situations such as sudden impulses to overeat, holidays, social eating events, stress and low mood. Stuckey et al. (2011) report that participants “planned their meals for the day in advance to avoid impulsive behaviour”. Other strategies included engaging family or friends in weight management behaviours, not giving in to peer pressure to eat more, and choosing not to attend social eating occasions. “Some people used to tell me that I look bad, that my body is too skinny and my complexion looks old. They say that I am not like I used to be. I have told them that I don’t intend to be like I used to be. I wanted to change and I have changed” (Maintainer) (Sarlio-Lähteenkorva, 2000). In contrast, regainers’ strategies for managing these influences

were poorly developed (McKee et al., 2013). Their accounts often suggested a relationship of dependence on external factors, particularly social influences. For instance, many reported dependence on ongoing social support programmes for weight management, because of the sense of peer acceptance, guidance and accountability they provided. Some maintainers also valued such support, but others were ambivalent about ongoing group membership because they perceived it as reducing their sense of personal control (Jallinoja et al., 2008). These findings are consistent with the idea that successful maintenance depends on management of external influences rather than management by them.

Willpower or Motivation. Several studies reported that successful maintenance required new sources of motivation, as motivations that were present during weight loss (e.g., awareness of improvements in functional capacity, positive feedback from others) became less noticeable (Cioffi, 2002; Karfopoulou et al., 2013; Reyes et al., 2012). This presented a problem for those who needed ongoing motivation or “willpower” to resist the tension created by their behaviour change, particularly in times of acute stress (Hindle & Carpenter, 2011). Some maintainers found new motivation through a sense of determination not to return to the “old me”, or by setting themselves new goals that required or would result in either maintenance or further weight loss. As one maintainer put it, “I could not appear at my workplace as an overblown fatty. Many in the audience would just stare at my fat body and miss the words. I used to do that myself. When I was obese, I always focused on the body shapes of others. This work requires that I am presentable, all the time” (Sarlio-Lähteenkorva, 2000).

Some people reported a need for extrinsic motivators, such as peer support from weight management groups (Hindle & Carpenter, 2011) or “catalytic interactions” from care providers (Bertz et al., 2015). For successful maintainers however, there was evidence of increased intrinsic motivation as they found enjoyment and satisfaction in lifestyle behaviours that underpinned their weight control, particularly physical exercise (Chambers & Swanson, 2012; Stuckey et al., 2011), and less dependence on external “pushes” (Haefele et al., 2011; Sarlio-

Lähteenkorva, 2000). These findings suggest that motivations for weight management change over time as individuals transition from weight loss to maintenance, and that intrinsic motivation may be particularly important to maintenance.

Reducing the tension.

The data suggested that successful maintainers found ways to go beyond resisting the tension of maintenance (fighting a never ending battle), and took steps to reduce or eliminate it. When this happened, it led to a more stable and less effortful pattern of weight maintenance. We identified three distinct ways that tension could be reduced or resolved.

Developing automaticity. Although some maintainers experienced an ongoing struggle with managing their weight, others reported that the new patterns of thinking and behaviour associated with their new lifestyle became more automated and habitual over time. These “advanced maintainers” thought less about their eating and physical activity behaviours and described them as “automatically programmed, natural and not subject to change” (Haeffele et al., 2011). In such cases, motivation seemed to play a lesser role, since the desired behaviours were enacted unconsciously, and did not drain cognitive resources. Maintainers actively used habit changing strategies, such as identifying situations in which unhelpful behavioural habits occurred and repeatedly using self-talk, distraction or other techniques to challenge the existing habit and establish an alternative, healthier habit in its stead. “The difficult bit was coming up with what that new routine would be but once that was in place it was kind of comforting” (Maintainer) (McKee et al., 2013).

Other examples included using cues or reminders to associate the new behaviours with particular contexts or times of day. For example, this could involve putting running shoes by the bed to step into each morning (Haeffele et al., 2011), or substituting chocolate with a lower calorie alternative when watching evening TV - effectively “piggy backing” on old habits to create new ones. Self-regulatory strategies, particularly self-monitoring and compensating for lapses, were also reported as habitual by some maintainers. Initially, the repetition of these

strategies required considerable cognitive resources, but in time they became automatic, and were no longer experienced as a burden. Successful maintainers sought to make habits of the behaviours they used to lose weight and to replace unhealthy habits with healthier and sustainable eating and physical activity behaviours that they found worked for them personally, or that fitted well with their lifestyle (Stuckey et al., 2011).

In contrast, regainers often treated weight loss behaviours as temporary measures and were less likely to convert them into habits. Post bariatric surgery, some people reported initial improvements in eating behaviours and a renewed sense of self-control, but others regressed. This was because their initially healthier food choices were driven by temporary adverse physiological responses to poor diet (e.g., rejection of fatty foods) rather than enjoyment, so once the physiological response reduced, old habits could return (Engstrom & Forsberg, 2011).

Meeting needs more healthily. Some maintainers reported finding alternative means of meeting needs that were previously fulfilled by obesogenic behaviours. For instance, some addressed perceived hunger with low calorie drinks (Karfopoulou et al., 2013), and others used physical exercise rather than food as a way to destress (Benson-Davies et al., 2013) or to provide a “high” (Green et al., 2009), or used other techniques such as self-talk, distraction or relaxation techniques to manage stress. The most common strategy to deal with emotional eating was to employ an alternative activity to either distract participants from the desire to eat or “to find some other release for what you are feeling” (Participant - Lynch & Bisogni, 2014). This approach required recognition of the needs that drive obesogenic behaviours (Hindle & Carpenter, 2011), and experimentation to find alternative ways of meeting these needs (Karfopoulou et al., 2013). It did not necessarily entail large step changes in the individual’s lifestyle, but could be achieved by implementing a series of smaller changes that still met the individual’s needs (Chambers & Swanson, 2012; Seale et al., 2013).

Changing beliefs and self-concept. The tension caused by unhelpful thoughts and beliefs can, in theory, be reduced by insights and by finding alternative ways of thinking. For

example, Maintainers tended to view weight management less as a challenging project and more as a long term change in lifestyle and were more positive about even small achievements (Byrne et al., 2003). They did not regard lapses as disasters but as events to learn from and move on from (McKee et al., 2013; Metzgar, Preston, Miller, & Nickols-Richardson, 2014; Seale et al., 2013). Many still found weight control challenging, but a flexible, self-forgiving and positive attitude was perceived as helpful.

In particular, successful long term weight loss maintenance was often accompanied by changes in self-concept (i.e., changes in the way individuals saw themselves and the way they related to the world). As one maintainer stated, “I feel like a new person. My whole life has changed. I could never go back again” (Berry, 2004). In contrast to the narrative of being trapped or helpless reported by some regainers, maintainers often talked about a growing sense of liberation and personal control, along with growing confidence and self-esteem and the emergence of a “new me”. Epiphaniou & Ogden (2010b) reported that “Following weight loss maintenance, participants described a shift in identity from that of a previously restricted individual who was restrained across a number of different domains, towards one who was liberated”. Maintainers spoke of a more positive body image following weight loss, but also of a decreasing preoccupation with weight and shape, possibly because their self-esteem was now less driven by body image and increasingly by other elements of their identity. In contrast, for regainers, body image often remained central to the self-concept and self-esteem and could continue to evoke negative and debilitating self-appraisals.

For some maintainers, the new self-concept was associated with the healthier lifestyle they had adopted, for instance seeing themselves as (and taking pride in being) an active person (Epiphaniou & Ogden, 2010b), a runner (Reyes et al., 2012), or a home chef (Barnes et al., 2007). Increased physical activity was commonly reported as integral to the lifestyle of maintainers. In some cases it was specifically seen as a weight control strategy, but in others it was more broadly embraced as part of the individual’s new life. Regainers, on the other hand,

often saw physical exercise as incongruent with their identity and lifestyle (Barnes et al., 2007; Chambers & Swanson, 2012).

The change in identity could go well beyond the realms of weight management, as the sense of renewed confidence prompted a realisation that positive change was possible in other areas of life. Maintainers described a process of evolution into a new person with a different outlook, social life, priorities, leisure pursuits and career.

And it's everything, joy and belief in the future, work and what I manage at work, there is just no comparison. Before it was just to get to work, to get out of the car, everything was a task, an effort and I often fell asleep before I got out of the car at home, you know I even fell asleep in the yard, my children found me there, because I could not manage any longer. And now when I get home it's like, well now I shall do this and that and I have other activities besides my job, like evening courses, so there is no comparison (Maintainer) (Engstrom & Forsberg, 2011).

Overview and relationship between themes and synthesis concepts.

The central concept of our analysis (represented by the spring in Fig.1) is that individuals experience a psychological conflict or "tension" when making the behavioural changes required for sustained weight loss. High levels of tension increase the likelihood of relapse and low tension is associated with maintenance. This tension may arise from several sources: The new lifestyle may conflict with existing habits, it may fail to satisfy personal needs or goals previously met by obesogenic behaviours (including social, emotional and hedonic needs), or because the lifestyle changes made are incongruent with the individual's existing beliefs and self-concept. This tension can be modified by a range of internal and external influences (depicted in the outer circle in Fig.1) that may change over time, such as mood and social interactions. The tension is experienced as an ever present debilitating struggle, and tends to draw the individual back to their previous obesogenic lifestyle and so to relapse. However, adoption of a number of approaches and strategies (as outlined above) can help manage the

tension or reduce it (even to the point of resolving it entirely), resulting in successful weight loss maintenance.

Sensitivity analyses and dissonant cases.

All the major synthesis themes are supported by at least four of the included studies (see Table 1). None of the themes were dependent solely on studies with low methodological rigour. However, two of the studies with low evidence of rigour did add some conceptual richness to the synthesis. In particular, Haeffele et al. (2011) suggested that maintenance of weight loss required a number of cognitive changes, including the development of intrinsic motivation for maintenance behaviours. Sarlio-Lahteenkorva (1998) proposed that unfulfilled personal needs and the perceived threat the new lifestyle posed to self-concept could be triggers for relapse.

With regard to differences in concepts and themes relating to bariatric surgery populations, none of the major synthesis themes was derived solely from studies in which initial weight loss was due to bariatric surgery. However, one of the strategies for reducing tension (finding alternative means to manage stress) was only seen in these studies. In addition, several of our synthesis themes were not well-represented in the studies with bariatric samples, particularly regarding the strategies of self-regulation, dealing with external influences, and developing automaticity. The conceptual focus of these studies was more on the experience of “tension” than its management.

We specifically sought examples of divergent and dissonant findings, and the following individual accounts appeared to diverge from our derived themes: One participant suggested that maintenance behaviours could never be automatic (Cioffi, 2002); “dieting” was portrayed in one study both an abnormal state and a normal part of modern life (Green et al., 2009); and negative self-judgements following lapses were voiced by some successful maintainers (Sarlio-Lähteenkorva, 2000). Whilst success in weight loss maintenance was generally associated with a greater sense of personal control, one study suggested that ongoing external accountability was also needed in the maintenance phase (Metzgar et al., 2014). A majority of studies

characterised maintenance as an ongoing struggle, even for successful maintainers, but two (Haeffele et al., 2011; Jallinoja et al., 2008) suggested that maintenance can get easier. These examples of apparent dissonance may be accounted for in our model by different participants having been more or less successful in resolving the tension of maintenance.

Discussion

Our synthesis identified a wide range of processes and modifying factors involved in long term weight management. It also generated a coherent model of weight loss maintenance, which was consistent with all the literature examined.

Our synthesis is consistent with quantitative literature on weight loss maintenance. Systematic reviews of weight loss maintenance interventions (Dombrowski et al., 2014; Simpson et al., 2011) suggest that self-regulation and problem solving are key skills for maintaining the lifestyle changes needed for weight loss. A systematic review of quantitative studies testing mediators of weight loss and maintenance (Teixeira et al., 2015), found that intrinsic motivation, positive body image and self-management skills such as self-monitoring and flexible eating restraint mediated long term weight control. Many of the synthesis themes and concepts are also echoed in studies correlating personal attributes and behaviours with success in weight loss maintenance. These include increasing insight into influences on behaviour (Colvin & Olson, 1983), positive attitudes towards weight management (Epiphaniou & Ogden, 2010a), practising self-regulation with flexible levels of self-restraint (Elfhag & Rossner, 2005; Teixeira et al., 2015), rapid compensation for and restoration after lapses (Grilo, Shiffman, & Wing, 1993; Wing & Phelan, 2005), and the use of physical activity to help maintain weight loss (Elfhag & Rossner, 2005).

Our synthesis is also consistent with prior reviews of qualitative evidence on weight management (Garip & Yardley, 2011; Gupta, 2014). In a review of 17 qualitative studies of weight management (mostly relating to weight loss), Garip (2011) identified several factors associated with successful weight management that are consistent with our synthesis. These

include thoughts and beliefs about weight management, self-perceptions, self-regulation, social, emotional and environmental influences (including habits and eating to regulate mood or emotional stress). They also emphasised the role of positive feedback (experiencing benefits from weight loss, and positive /supportive experiences of the weight loss programme) as a factor that may provide ongoing motivation. Gupta (2014) conducted a thematic analysis of qualitative and quantitative data which included nine qualitative studies. This identified similar themes to Garip (2011) as well as suggesting a possible relation between camaraderie in group-based interventions and long-term weight loss maintenance. Our review adds to these studies by a) identifying a larger sample of studies, with a specific focus on weight loss maintenance and b) synthesising the data into a coherent model of weight loss maintenance.

Our synthesis is also consistent with a recent review of theories of maintenance of health behaviour change (Kwasnicka, Dombrowski, White, & Sniehhota, 2016). This identified several major themes: motivation (including satisfaction and enjoyment of the behaviour, and its congruence with identity and values), self-regulation, habit development, external influences, and the psychological resource costs of maintenance, all of which are represented in our model.

The model we have developed suggests several novel ideas for interventions to support weight loss maintenance. One approach might be to identify the sources and modifiers of tension for an individual and use this information to guide personalised interventions. This would require the assessment of the psychological and identity related needs that are currently served by obesogenic behaviours, as well as the range of (positive and negative) internal and external factors influencing the individual's behaviour. A personal profile based on this assessment could be used to target intervention strategies.

The idea of encouraging "flexible restraint" when self-monitoring weight or behaviours is consistent with other literature (Benn et al., 2016; Ferguson, Brink, Wood, & Koop, 1992; Westenhoefer et al., 2013). This implies that interventions should take steps to avoid

catastrophic interpretation of lapses. They should also encourage specific action plans and self-monitoring whilst avoiding unrealistically rigid rules. For example, this might involve setting a target weight with an acceptable range (e.g., the weight that I want to maintain is 74Kg and I will take action if it goes above 75Kg), or specifying changes which incorporate some flexibility (e.g., I will walk the dog for 10-20 minutes every Wednesday evening).

The model also suggests that interventions should aim to help disrupt obesogenic habits and to establish new habits that support weight control. Theories have been developed to explain the processes of habit change (Rothman, Sheeran, & Wood, 2009; Verplanken, 2006), and interventions based on these are available (Adriaanse, Gollwitzer, De Ridder, de Wit, & Kroese, 2011). However, there are only a few examples of such strategies being used to support weight management (Gardner, Sheals, Wardle, & McGowan, 2014; van't Riet, Sijtsma, Dagevos, & De Bruijn, 2011). Hence further research is needed to evaluate the effectiveness of habit changing intervention techniques for weight loss maintenance.

It is not clear whether changes in self-concept are a cause or a consequence of improved maintenance. However, their close association suggests that it may be worth evaluating intervention strategies to encourage the development of identity related beliefs that are consistent with energy balanced lifestyles. It may be feasible, for instance, to facilitate changes in personal and social identity beliefs, similar to those described in our analysis, such as becoming a healthy person, or being a role model for others (Wang, Shih, & Carroll, 2015).

Although our model suggests that interventions should target the management and resolution of tension, it also implies that tension could be prevented by making lifestyle changes at the weight loss stage that are less likely to conflict with personal needs or self-concept. For instance, if larger changes generate higher levels of tension, as the model would suggest, we speculate that making a series of small changes (which nevertheless add up to a substantial change in energy balance) might induce a more manageable pattern of tension (spread across several domains /contexts /times of day) than a large context-specific change

(such as skipping a meal each day). This idea is currently recommended by NICE (2014) guidance on obesity management, based largely on expert opinion. Further research is needed to assess whether and in what circumstances this approach might be beneficial. Another idea for preventing tension would be to check the likely sustainability of behavioural changes at the planning stage (i.e., aiming to make changes for life rather than the short term). The majority of weight loss maintenance interventions to date have taken the approach of adding an intervention at the end of the weight loss phase (Dombrowski et al., 2014). However, given that many of the ideas we have proposed for interventions could also be applied to initial weight loss, it may be preferable to integrate these weight loss maintenance components within weight loss programmes, rather than adding them post weight loss.

Strengths, limitations and suggestions for further research.

The main strength of our synthesis is the generation of a coherent and parsimonious model that incorporates and summarises the main themes identified in the included papers, posits relationships between them, and depicts a process through which they may be addressed. However, the synthesis may be limited by several methodological issues. The literature search may not have been exhaustive, although we included a wide range of studies from different disciplines with a variety of sample characteristics and using different methodological approaches. The quality appraisal scheme we used was adapted from published systems but has not been validated, and involved subjective judgements by the researchers. However, the involvement of two researchers in the process provided some protection against subjective bias. Regarding data saturation, we found that the findings in the last five papers analysed generated no new major themes. The proposed model is based almost entirely on retrospective accounts provided at a single time point, so, to some extent the findings may reflect post hoc rationalisation of events. Hence, there is a need for more prospective longitudinal studies to examine whether changes over time in such variables as insight, automaticity, perceived “tension” and self-concept, are indeed associated with success in maintenance. Observational,

“in the moment” methods such as ecological momentary assessment might also help to identify such mechanisms in action. Research to identify how unhealthy habits (and the other sources of tension) develop in childhood and the possible role of parenting interactions might help to identify more preventative intervention strategies. The data was dominated by narratives concerned with managing food intake, so the challenges of maintaining changes in physical activity were not fully explored, and further research in this area is warranted. It was not possible to differentiate the views of women and men in the included studies, although the differential impacts of culture and physiology according to gender could produce differences in the dynamics of contextual influences and their management. Finally, the transferability of the data to bariatric surgery populations may be limited, particularly regarding the strategies of self-regulation, dealing with external influences, and developing automaticity. These issues require further study.

Conclusions

This study has created a model of weight loss maintenance that is firmly based on the personal stories of people who are trying to control their weight. It is therefore a credible and relevant resource both to increase our understanding of their experience and perspectives, and to inform development of interventions that can support their efforts.

Acknowledgements

The authors would like to thank the members of our service user group who discussed the concepts and ideas in the model to help us interpret the findings. We also thank Dr Afroditi Stathi (University of Bath) and Dr Dominika Kwasnicka (Newcastle University) who commented on earlier versions of the manuscript.

Competing interests: The author(s) declare that they have no competing interests.

References

- Adams, T. D., Davidson, L. E., Litwin, S. E., Kolotkin, R. L., LaMonte, M. J., Pendleton, R. C., . . . Hunt, S. C. (2012). Health benefits of gastric bypass surgery after 6 years. *JAMA*, 308(11), 1122-1131. doi: 10.1001/2012.jama.11164
- Adriaanse, M. A., Gollwitzer, P. M., De Ridder, D. T., de Wit, J. B., & Kroese, F. M. (2011). Breaking habits with implementation intentions: a test of underlying processes. *Pers Soc Psychol Bull*, 37(4), 502-513. doi: 10.1177/0146167211399102
- Avenell, A., Broom, J., Brown, T. J., Poobalan, A., Aucott, L., Stearns, S. C., . . . Grant, A. M. (2004). Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement. *Health Technol Assess*, 8(21), iii-iv, 1-182.
- Barnes, A. S., Goodrick, G. K., Pavlik, V., Markesino, J., Laws, D. Y., & Taylor, W. C. (2007). Weight loss maintenance in African-American women: focus group results and questionnaire development. *J Gen Intern Med*, 22(7), 915-922. doi: 10.1007/s11606-007-0195-3
- Barnett-Page, E., & Thomas, J. (2009). Methods for the synthesis of qualitative research: a critical review. *BMC Med Res Methodol*, 9, 59. doi: 1471-2288-9-59 [pii] 10.1186/1471-2288-9-59
- Benn, Y., Webb, T. L., Chang, B. P. I., & Harkin, B. (2016). What is the psychological impact of self-weighing? A meta-analysis. *Health Psychology Review*, 10, 187-203. doi: 10.1080/17437199.2016.1138871
- Benson-Davies, S., Davies, M. L., & Kattelman, K. (2013). Understanding Eating and Exercise Behaviors in Post Roux-en-Y Gastric Bypass Patients: A Quantitative and Qualitative Study. *Bariatric Surg Pract Patient Care*, 8, 61-68.
- Berry, D. (2004). An emerging model of behavior change in women maintaining weight loss. *Nurs Sci Q*, 17(3), 242-252. doi: 10.1177/0894318404266323
- Bertz, F., Sparud-Lundin, C., & Winkvist, A. (2015). Transformative Lifestyle Change: Key to sustainable weight loss among women in a post-partum diet and exercise intervention. *Maternal and Child Nutrition*, 11, 631-645.
- Britten, N., Campbell, R., Pope, C., Donovan, J., Morgan, M., & Pill, R. (2002). Using meta ethnography to synthesise qualitative research: a worked example. *J Health Serv Res Policy*, 7(4), 209-215. doi: 10.1258/135581902320432732

- Byrne, S., Cooper, Z., & Fairburn, C. (2003). Weight maintenance and relapse in obesity: a qualitative study. *Int J Obes Relat Metab Disord*, 27(8), 955-962. doi: 10.1038/sj.ijo.0802305
- Carroll, C., Booth, A., & Cooper, K. (2011). A worked example of "best fit" framework synthesis: a systematic review of views concerning the taking of some potential chemopreventive agents. *BMC Med Res Methodol*, 11, 29. doi: 1471-2288-11-29 [pii] 10.1186/1471-2288-11-29
- Carroll, C., Booth, A., & Lloyd-Jones, M. (2012). Should we exclude inadequately reported studies from qualitative systematic reviews? An evaluation of sensitivity analyses in two case study reviews. *Qualitative Health Research*, 22(10), 1425-1434. doi: 10.1177/1049732312452937
- Chambers, J. A., & Swanson, V. (2012). Stories of weight management: factors associated with successful and unsuccessful weight maintenance. *Br J Health Psychol*, 17(2), 223-243. doi: 10.1111/j.2044-8287.2011.02030.x
- Cioffi, J. (2002). Factors that enable and inhibit transition from a weight management program: a qualitative study. *Health Educ Res*, 17(1), 19-26.
- Colvin, R. H., & Olson, S. B. (1983). A descriptive analysis of men and women who have lost significant weight and are highly successful at maintaining the loss. *Addict Behav*, 8(3), 287-295.
- Dansinger, M. L., Tatsioni, A., Wong, J. B., Chung, M., & Balk, E. M. (2007). Meta-analysis: the effect of dietary counseling for weight loss. *Ann Intern Med*, 147(1), 41-50.
- Dombrowski, S. U., Knittle, K., Avenell, A., Araujo-Soares, V., & Sniehotta, F. F. (2014). Long-term maintenance of weight loss in obese adults: A systematic review of randomised controlled trials of non-surgical weight loss maintenance interventions with meta-analyses *BMJ*, 348, g2646.
- Elfhag, K., & Rossner, S. (2005). Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obes Rev*, 6(1), 67-85. doi: 10.1111/j.1467-789X.2005.00170.x
- Engstrom, M., & Forsberg, A. (2011). Wishing for deburdening through a sustainable control after bariatric surgery. *Int J Qual Stud Health Well-being*, 6.
- Epiphaniou, E., & Ogden, J. (2010a). Evaluating the role of life events and sustaining conditions in weight loss maintenance. *J Obes*, Article ID 859413. doi: 10.1155/2010/859413

- Epiphanidou, E., & Ogden, J. (2010b). Successful Weight Loss Maintenance and a Shift in Identity From Restriction to a New Liberated Self. *J Health Psychol*, 15(6), 887-896. doi: 10.1177/1359105309358115
- Ferguson, K. J., Brink, P. J., Wood, M., & Koop, P. M. (1992). Characteristics of successful dieters as measured by guided interview responses and Restraint Scale scores. *J Am Diet Assoc*, 92(9), 1119-1121.
- Gardner, B., Sheals, K., Wardle, J., & McGowan, L. (2014). Putting habit into practice, and practice into habit: a process evaluation and exploration of the acceptability of a habit-based dietary behaviour change intervention. *Int J Behav Nutr Phys Act*, 11, 135. doi: 10.1186/s12966-014-0135-7
- Garip, G., & Yardley, L. (2011). A synthesis of qualitative research on overweight and obese people's views and experiences of weight management. *Clinical Obesity*, 1(2-3), 110-126. doi: 10.1111/j.1758-8111.2011.00021.x
- Greaves, C. J., Sheppard, K. E., Abraham, C., Hardeman, W., Roden, M., Evans, P. H., & Schwarz, P. (2011). Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health*, 11, 119. doi: 10.1186/1471-2458-11-119
- Green, A. R., Larkin, M., & Sullivan, V. (2009). Oh stuff it! The experience and explanation of diet failure: an exploration using interpretative phenomenological analysis. *J Health Psychol*, 14(7), 997-1008. doi: 10.1177/1359105309342293
- Grilo, C. M., Shiffman, S., & Wing, R. R. (1993). Coping with dietary relapse crises and their aftermath. *Addict Behav*, 18(1), 89-102.
- Gupta, H. (2014). Barriers to and Facilitators of Long Term Weight Loss Maintenance in Adult UK People: A Thematic Analysis. *Int J Prev Med*, 5(12), 1512-1520.
- Haeffele, J., Trunnell, E. P., & Kinney, A. (2011). A Grounded Theory Approach to the Process of Successful and Advanced Weight Maintenance. *Int J Health Wellness Soc*, 1(3), 43-54.
- Hannes, K., & Macaitis, K. (2012). A move to more systematic and transparent approaches in qualitative evidence synthesis: update on a review of published papers. *Qualitative Research*, 12(4), 402-442. doi: 10.1177/1468794111432992
- Hindle, L., & Carpenter, C. (2011). An exploration of the experiences and perceptions of people who have maintained weight loss. *Journal of Human Nutrition and Dietetics*, 24(4), 342-350. doi: 10.1111/j.1365-277X.2011.01156.x

- Jallinoja, P., Pajari, P., & Absetz, P. (2008). Repertoires of lifestyle change and self-responsibility among participants in an intervention to prevent type 2 diabetes. *Scand J Caring Sci*, 22, 455-462.
- Janse Van Vuuren, M., Strodl, E., White, K. M., & Lockie, P. (2015). Psychosocial presentation of revisional LAGB patients: a qualitative study. *Clin Obes*. doi: 10.1111/cob.12113
- Karfopoulou, E., Mouliou, K., Koutras, Y., & Yannakoulia, M. (2013). Behaviours associated with weight loss maintenance and regaining in a Mediterranean population sample. A qualitative study. *Clinical Obesity*, 3(5), 141-149. doi: 10.1111/cob.12028
- Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehhota, F. (2016). Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychology Review*, 10(3). doi: 10.1080/17437199.2016.1151372
- Lynch, A., & Bisogni, C. A. (2014). Gastric bypass patients' goal-strategy-monitoring networks for long-term dietary management. *Appetite*, 81, 138-151.
- Madigan, C. D., Aveyard, P., Jolly, K., Denley, J., Lewis, A., & Daley, A. J. (2014). Regular self-weighing to promote weight maintenance after intentional weight loss: a quasi-randomized controlled trial. *J Public Health (Oxf)*, 36(2), 259-267. doi: 10.1093/pubmed/fdt061
- McKee, H., Ntoumanis, N., & Smith, B. (2013). Weight maintenance: self-regulatory factors underpinning success and failure. *Psychol Health*, 28(10), 1207-1223. doi: 10.1080/08870446.2013.799162
- Metzgar, C. J., Preston, A. G., Miller, D. L., & Nickols-Richardson, S. M. (2014). Facilitators and barriers to weight loss and weight loss maintenance: a qualitative exploration. *Journal of Human Nutrition and Dietetics*, online first. doi: 10.1111/jhn.12273
- NICE (2014). CG189 - Obesity: identification, assessment and management of overweight and obesity in children, young people and adults. London: National Institute for Health and Clinical Excellence (UK).
- Ogden, J., & Hills, L. (2008). Understanding sustained behavior change: the role of life crises and the process of reinvention. *Health (London)*, 12(4), 419-437. doi: 10.1177/1363459308094417
- Padwal, R. S., & Majumdar, S. R. (2007). Drug treatments for obesity: orlistat, sibutramine, and rimonabant. *Lancet*, 369(9555), 71-77. doi: 10.1016/S0140-6736(07)60033-6

- Reilly, A., Mawn, B., Susta, D., Staines, A., Browne, S., & Sweeney, M. R. (2015). Lessons learned about primary weight maintenance and secondary weight maintenance: results from a qualitative study. *BMC Public Health*, 15, 580.
- Reyes, N. R., Oliver, T. L., Klotz, A. A., LaGrotte, C. A., Vander Veur, S. S., Virus, A., . . . Foster, G. D. (2012). Similarities and Differences between Weight Loss Maintainers and Regainers: A Qualitative Analysis. *J Acad Nutr Diet*, 112(4), 499-505. doi: 10.1016/j.jand.2011.11.014
- Rothman, A. J., Sheeran, P., & Wood, W. (2009). Reflective and automatic processes in the initiation and maintenance of dietary change. *Ann Behav Med*, 38 Suppl 1, S4-17. doi: 10.1007/s12160-009-9118-3
- Sarlio-Lahteenkorva, S. (1998). Relapse stories in obesity. *Eur J Public Health*, 8(3), 203-209. doi: 10.1093/eurpub/8.3.203
- Sarlio-Lähteenkorva, S. (2000). 'The Battle is Not Over after Weight Loss': Stories of Successful Weight Loss Maintenance. *Health*, 4(1), 73-88. doi: 10.1177/136345930000400104
- Seale, J. P., Fifield, J., Davis-Smith, Y. M., Satterfield, R., Thomas, J. G., Cole, B., . . . Boltri, J. M. (2013). Developing culturally congruent weight maintenance programs for African American church members. *Ethn Health*, 18(2), 152-167. doi: 10.1080/13557858.2012.708914
- Simpson, S. A., Shaw, C., & McNamara, R. (2011). What is the most effective way to maintain weight loss in adults? *BMJ*, 343, d8042. doi: 10.1136/bmj.d8042
- Sjostrom, L. (2013). Review of the key results from the Swedish Obese Subjects (SOS) trial - a prospective controlled intervention study of bariatric surgery. *J Intern Med*, 273(3), 219-234. doi: 10.1111/joim.12012
- Stuckey, H. L., Boan, J., Kraschnewski, J. L., Miller-Day, M., Lehman, E. B., & Sciamanna, C. N. (2011). Using positive deviance for determining successful weight-control practices. *Qual Health Res*, 21, 563-579.
- Teixeira, P. J., Carraca, E. V., Marques, M. M., Rutter, H., Oppert, J. M., De Bourdeaudhuij, I., . . . Brug, J. (2015). Successful behavior change in obesity interventions in adults: a systematic review of self-regulation mediators. *BMC Med*, 13, 84. doi: 10.1186/s12916-015-0323-6
- Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, 8, 45. doi: 10.1186/1471-2288-8-45

- Tong, A., Flemming, K., McInnes, E., Oliver, S., & Craig, J. (2012). Enhancing transparency in reporting the synthesis of qualitative research: ENTREQ. *BMC Med Res Methodol*, 12, 181. doi: 10.1186/1471-2288-12-181
- van't Riet, J., Sijtsema, S. J., Dagevos, H., & De Bruijn, G. J. (2011). The importance of habits in eating behaviour. An overview and recommendations for future research. *Appetite*, 57(3), 585-596. doi: 10.1016/j.appet.2011.07.010
- Verplanken, B. (2006). Beyond frequency: habit as mental construct. *Br J Soc Psychol*, 45(Pt 3), 639-656. doi: 10.1348/014466605X49122
- Wallace, A., Croucher, K., Bevan, M., Jackson, K., O'Malley, L., & Quilgars, D. (2006). Evidence for policy making: Some reflections on the application of systematic reviews to housing research. *Housing Studies*, 21(2), 297-314. doi: 10.1080/02673030500484935
- Walsh, D., & Downe, S. (2006). Appraising the quality of qualitative research. *Midwifery*, 22(2), 108-119. doi: 10.1016/j.midw.2005.05.004
- Wang, J., Shih, P. C., & Carroll, J. M. (2015). Life after weight loss: Design implications for community-based long-term weight management. *Computer Supported Cooperative Work (CSCW)*, 24, 353-384. doi: <http://dx.doi.org/10.1007/s10606-015-9226-5>
- Westenhoefer, J., Engel, D., Holst, C., Lorenz, J., Peacock, M., Stubbs, J., . . . Raats, M. (2013). Cognitive and weight-related correlates of flexible and rigid restrained eating behaviour. *Eat Behav*, 14(1), 69-72. doi: 10.1016/j.eatbeh.2012.10.015
- WHO (2014). Obesity. Retrieved October 31st, 2014, from <http://www.who.int/topics/obesity/en/>
- Wing, R. R., & Phelan, S. (2005). Long-term weight loss maintenance. *Am J Clin Nutr*, 82(1 Suppl), 222S-225S.
- Wingham, J., Harding, G., Britten, N., & Dalal, H. (2014). Heart failure patients' attitudes, beliefs, expectations and experiences of self-management strategies: A qualitative synthesis. *Chronic Illn*, 10(2), 135-154. doi: 10.1177/1742395313502993
- Wong, S. S., Wilczynski, N. L., & Haynes, R. B. (2004). Developing optimal search strategies for detecting clinically relevant qualitative studies in MEDLINE. *Studies in Health Technology and Informatics*, 107(1), 311-316. doi: 10.3233/978-1-60750-949-3-311

Table 1: Evidence underpinning key concepts in the analysis

Synthesis concept	Themes and sub-themes derived from studies	Supporting studies
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The tension of maintenance**Maintaining the changes is a struggle**

- A constant battle [1-5]
- Mental fatigue of sustaining behaviour [1, 6-8]
- Psychological toll leads to relapse [4, 9-12]

Sources of tension**Old habits and impulses**

- Need to change eating and physical activity habits [3, 7, 10, 13-15]
- Tendency to return to old habits. [10, 11, 13, 16-18]

Unmet needs

- Obesogenic behaviour serves personal needs [1, 9, 11, 13, 19-23]
- Mood / stress regulation [1, 11, 12, 17, 19-23]
- Relief of boredom [17, 21]
- Pleasure [4, 16, 19]
- Social acceptance [12, 18, 23]

Thoughts and beliefs about identity or self-concept

- Missing the “old me” [4, 5]

Synthesis concept	Themes and sub-themes derived from studies	Supporting studies
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- | | | |
|--|--|-------------|
| | <ul style="list-style-type: none"> Discomfort with new body image | [4, 12, 20] |
|--|--|-------------|

Thoughts and beliefs about weight management

- | | |
|--|--------------------------|
| <ul style="list-style-type: none"> Rigid, rule-bound thinking | [7, 20, 24] |
| <ul style="list-style-type: none"> Negative attributions about weight management | [2, 5-7, 10, 12, 20, 21] |
| <ul style="list-style-type: none"> Seeing weight management as a temporary, unnatural behaviour | [6, 7, 24] |
| <ul style="list-style-type: none"> Catastrophic thinking in response to lapses | [11, 24] |
| <ul style="list-style-type: none"> Dissatisfaction with outcomes | [6, 7, 11] |

Modifiers of tension

Factors influencing the challenge of maintenance

- | | |
|--|-------------------------------------|
| <ul style="list-style-type: none"> Personal circumstances, e.g., health, finances, mood | [2, 6, 7, 20, 21, 24] |
| <ul style="list-style-type: none"> Attitudes of family, friends, peers | [2, 11-13, 16, 23] |
| <ul style="list-style-type: none"> Environmental factors, e.g., seasons, work, holidays | [2, 4-6, 11, 13-16, 18, 21, 23, 24] |
| <ul style="list-style-type: none"> Influences vary over time and in intensity | [2, 6, 10, 13, 14] |

Managing the tension

Learning and insight

- | | |
|---|----------------------------------|
| <ul style="list-style-type: none"> Understanding influences on own behaviour | [1-3, 6, 9, 10, 13, 15, 21, 22]. |
|---|----------------------------------|

Synthesis concept	Themes and sub-themes derived from studies	Supporting studies
	<ul style="list-style-type: none"> • Learning from experiences (including lapses) 	[2-4, 7, 9, 22, 24]
	<ul style="list-style-type: none"> • Maladaptive learning 	[20, 21, 23]
	<ul style="list-style-type: none"> • New knowledge leads to new plans and behaviours 	[1, 2, 9, 11, 13]
	Self-regulation	
	<ul style="list-style-type: none"> • Maintenance through self-regulation of thoughts and behaviours 	[2, 6, 7, 9, 14, 20, 21, 24, 25]
	<ul style="list-style-type: none"> • Regainers not self-regulating 	[7, 14, 20, 24]
	<ul style="list-style-type: none"> • Managing impulses 	[25]
	<ul style="list-style-type: none"> • Self-monitoring 	[2, 6-9, 14, 20, 21, 24, 25]
	<ul style="list-style-type: none"> • Setting boundaries as triggers for action 	[1, 4, 14, 24]
	<ul style="list-style-type: none"> • Compensating for lapses 	[6, 7, 14, 17, 19, 20, 24]
	<ul style="list-style-type: none"> • Flexible restraint of behaviour 	[2, 4, 7, 17, 20, 21, 24].
	Managing internal and external influences	
	<ul style="list-style-type: none"> • Managing “high risk situations” 	[1, 4, 6, 13, 20, 24]
	<ul style="list-style-type: none"> • Co-opting friends or family 	[2, 16]
	<ul style="list-style-type: none"> • Resisting social pressures 	[4, 19]

Synthesis concept	Themes and sub-themes derived from studies	Supporting studies
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- | | | |
|--|--|---------------------------|
| | • Avoiding temptations | [12] |
| | • Regainers don't manage influences | [7] |
| | • Dependence on weight management groups | [2, 8-10, 14, 16, 25, 26] |

Willpower or motivation

- | | | |
|--|---|----------------|
| | • Not wanting to return to former self | [4, 6, 13, 21] |
| | • Taking on new roles or goals that require maintenance | [4, 8] |

Reducing the tension

Developing automaticity

- | | | |
|--|--|---------------------|
| | • New lifestyle becoming habitual or "natural" | [1, 3, 9, 16, 25] |
| | • Self-regulation becoming habitual | [2, 20] |
| | • Becoming less fatiguing or easier over time | [1, 3, 6, 7, 14-16] |
| | • Deliberate efforts to change habits | [1, 6, 7, 14, 20] |

Meeting needs more healthily

- | | | |
|--|---|----------|
| | • Finding alternative ways to manage stress | [13, 17] |
| | • Finding other ways to deal with emotions | [6, 17] |
| | • Finding enjoyment through physical activity or healthy eating | [5] |

Synthesis concept	Themes and sub-themes derived from studies	Supporting studies
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Changing beliefs and self-concept		
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- | | |
|--|--------------------------------|
| • Sense of being a new person | [4, 7, 9, 11, 14, 16, 18, 21]. |
| • Taking on new roles or goals | [4, 21] |
| • Seeing weight management as integral part of new lifestyle | [2, 9, 25] |
| • Maintainers less preoccupied with weight and shape | [9, 16, 20] |
| • Regainers remain preoccupied with weight and shape | [11, 21] |
| • Greater sense of self-control | [9, 11, 13, 16, 21] |
| • Increased self-esteem | [9, 11, 16, 20] |
| • Seeing physical activity as integral to new identity | [2, 4, 9, 14, 20, 21, 24] |

[1] Haefele et al., 2011; [2] Hindle & Carpenter, 2011; [3] Jallinoja et al., 2008; [4] Sarlio-Lähteenkorva, 2000; [5] Green et al., 2009; [6] Karfopoulou et al., 2013; [7] McKee, Ntoumanis, & Smith, 2013; [8] Wang, Shih, & Carroll, 2015; [9] Berry, 2004; [10] Cioffi, 2002; [11] Engstrom & Forsberg, 2011; [12] Sarlio-Lahteenkorva, 1998; [13] Benson-Davies et al., 2013; [14] Reyes et al., 2012; [15] Seale et al., 2013; [16] Bertz et al., 2015; [17] Lynch & Bisogni, 2014; [18] Reilly et al., 2015; [19] Barnes et al., 2007; [20] Byrne et al., 2003; [21] Epiphaniou & Ogden, 2010; [22] Ogden & Hills, 2008; [23] Janse Van Vuuren et al., 2015; [24] Chambers & Swanson, 2012; [25] Stuckey et al., 2011; [26] Metzgar, Preston, Miller, & Nickols-Richardson, 2014

Figure 1: Prisma flowchart for study

Figure 2: Conceptual model of the dynamics of weight loss maintenance

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